GOVERNMENT OF INDIA
AGRICULTURE
LOK SABHA

UNSTARRED QUESTION NO:1098
ANSWERED ON:01.03.2000
RESEARCH INSTITUTIONS
SUSHIL KUMAR INDORA

Will the Minister of AGRICULTURE be pleased to state:

(a) whether the Government are running research and analysis institutes for the development of agriculture;

(b) if so, the names of those research institutes which are entirely dependent on the Government for financial assistance;

(c) whether any new invention has been made by these institutes with their research and analysis during the last three years;

(d) if so, the details thereof; and

(e) the steps being taken by the Government so as to reach the benefits of these inventions to the farmers?

Answer

THE MINISTER OF STATE IN THE MINISTRY OF AGRICULTURE (SHRI HUKUMDEO NARAYAN YADAV)

(a) Yes, Sir.

(b) As per Annexure-I.

(c) Yes, Sir,

(d) As per Annexure-II.

(e) There are 261 Krishi Vigyan Kendras (KVKS) in the Country that are engaged in the process of technologydissemination. The Council have identified 53 districts to strengthen the existing Zonal Agricultural ResearchStations (ZARS) where there is no KVK to take up additional functions of KVK. The ICAR has also launched an Institution-Village-Linkage Programme for transfer of Technology. Frontline demonstration of technologies is another mechanism to transfer the agricultural technologies developed by the Research & Development institutes for the benefit of farmers. For effective dissemination of information, the Council has sanctioned establishment of 40 Agricultural Technology Information Centres (ATIC). These will serve as a single window system with anobjective to provide solution to problems and information dissemination. An inter-divisional effort between Crop Science and Extension Divisions of ICAR has led to formulation and development of a project on `Technology Evaluation and Impact Assessmen` for faster dissemination of both knowledge and technology.

ANNEXURE-I

NATIONAL INSTITUTES

1. Indian Agricultutral Research Institute, New Delhi

2. Indian Veterinary Research Institute, Izatnagar.

3. National Dairy Research Institute, Karnal

4. Central Institute of Fisheries Education, Mumbai

5. Central Agricultural Research Institute, Port Blair
6. Central Arid Zone Research Institute, Jodhpur

7 Central Institute of Agricultural Engineering, Bhopal

8. Central Institute for Cotton Research, Nagpur

9. Central Institute of Post-Harvest Engineering & Technology, Ludhiana

10. Central Institute for Research on Cotton Technology, Mumbai
11. Central Institute for Subtropical Horticulture, Lucknow
12. Central Institute for Temperate Horticulture, Srinagar
13. Central Plantation Crop Research Institute, Kasaragod
14. Central Potato Research Institute, Shimla
15. Central Research Institute for Dryland Agriculture, Hyderabad
16. Central Research Institute for Jute and Allied Fibres, Barrackpore
17. Central Rice Research Institute, Cuttack
18. Central Soil Salinity Research Institute, Karnal
19. Central Soil & Water Conservation Research & Training Institute, Dehradun
20. Central Tobacco Research Institute, Rajahmundry
21. Central Tuber Crops Research Institute, thiruvananthapuram
22. ICAR Research Complex for GOA, Goa
23. ICAR Research Complex for North Eastern Hills Region, Barapani
24. Indian Agricultural Statistics Research Institute, New Delhi
25. Indian Grassland and Fodder Research Institute, Jhansi
26. Indian Institute of Horticultural Research, Bangalore
27. Indian Institute of Soil Science, Bhopal
28. Indian Institute of Spices Research, Calicut
29. Indian Institute of Sugarcane Research, Lucknow
30. Indian Lac Research Institute, Ranchi
31. Indian Institute of Pulses Research, Kanpur
32. National Institute of Research on Jute & Allied Fibre Technology, Calcutta
33. Sugarcane Breeding Institute, Coimbatore
34. Vivekanand Parvatiya Krishi Anusandhan Shala, Almora
35. Central Avian Research Institute, Izatnagar
36. Central Inland Capture Fisheries Research Institute, Barrackpore
37. Central Institute of Brackishwater Aquaculture, Chennai
38. Central Institute of Fisheries Technology, Kochi
39. Central Institute of Freshwater Aquaculture, Bhubaneshwar
40. Central Institute for Research on Buffaloes, Hisar
41. Central Institute for Research on Goats, Makhdoom
42. Central Marine Fisheries Research Institute, Kochi
43. Central Sheep & Wool Research Institute, Avikanagar
44. National Institute of Animal Nutrition and Physiology, Bangalore
45. National Academy of Agricultural Research and Management, Hyderabad
46. Indian Institute of Vegetable Research, Varanasi
47. National Bureau of Plant Genetic Resources, New Delhi
48. National Bureau of Soil Survey and Land Use Planning, Nagpur
49. National Bureau of Animal Genetic Resources, Karnal
50. National Bureau of Fish Genetic Resources, Lucknow
51. Directorate of Cropping Systems Research, Meerut
52. Directorate of Oilseed Research, Hyderabad
53. Directorate of Rice Research, Hyderabad
54. Directorate of Wheat Research, Karnal
55. Project Directorate of Biological Control, Bangalore
56. Project Directorate of Maize, New Delhi
57. Directorate of Water Management Research, Patna
58. Project Directorate on Cattle, Meerut
59. Project Directorate on Poultry, Hyderabad
60. Project Directorate of Soyabean Processing & Utilization, Bhopal
61. National Research Centre for Agroforestry, Jhansi
62. National Research Centre for Arid Horticulture, Bikaner
63. National Research Centre for Banana, Tiruchirapalli
64. National Research Centre for Cashew, Puttur
65. National Research Centre for Citrus, Nagpur
66. National Research Centre for Grapes, Pune
67. National Research Centre for Groundnut, Junagarh
68. National Research Centre for Integrated Pest Management, New Delhi
69. National Research Centre for Medicinal and Aromatic Plants, Anand
70. National Research Centre for Mushroom Research and Training, Solan
71. National Research Centre for Oilpalm, Eluru
72. National Research Centre for Onion and Garlic, Pune
73. National Research Centre for Orchids, Gangtok
74. National Research Centre for Plant Biotechnology, New Delhi
75. National Research Centre for Rapseed & Mustard, Bharatpur
76. National Research Centre for Sorghum, Hyderabad
77. National Research Centre on Soybean, Indore
78. National Research Centre for Water Technology, Bhubaneshwar
79. National Research Centre for Weed Science, Jabalpur
80. High Security Animal Disease Laboratory, Bhopal
81. National Research Centre on Camel, Bikaner
82. National Research Centre for Coldwater Fisheries, Nainital
83. National Research Centre for Equines, Hisar
84. National Research Centre on Meat & Meat Products, Hyderabad
85. National Research Centre on Mithun, Kohima
86. National Research Centre on Yak, Dirang
87. N. R. C. for Agricultural Economics & Policy Research, New Delhi
88. National Research Centre for Women in Agriculture, Bhubaneswar

ALL INDIA COORDINATED RESEARCH PROJECTS

CROP SCIENCE

1. Dr. B. Malik,
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(Karnataka) 560 024.

2. Dr. P. Shyam Sunder Rao,
Project Coordinator(Network on Agricultural Ornithology), ANGRAU
Veterinary College Campus, Rajendranagar, Hyderabad-500 030(A.P.)

3. Dr. R.C. Sharma,
Project Coordinator(Arid Legumes), RAU, Beehwal, Bikaner(Rajasthan).

4. Dr. C. Hanumantha Rao,
Project Coordinator(Castor), Directorate of Oilseed Research,
Hyderabad-500 030(A.P.)

5. Dr. Masood Ali,
Project Cooridnator(Chickpea), Indian Institute of Pulses Research,
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6. Dr. K. Venugopal,
Project Coordinator(Cotton), Regional Research Station(CICR), PO Lawely Road,
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7. Dr. N.P. Melkania,
Project Coordinator(Forage Crops), Indian Grassland and Fodder Research Institute,
PO Pahuj Dam, Jhansi-Gwalior Road, Jhansi-284 003 (U.P.)

8. Dr. M.S. Basu,

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9. Dr. R.C. Mishra,
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10. Dr. B.B. Das,
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11. Dr. C.H. Hanumantha Rao,
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12, Dr. A. Seetharam,
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13. Dr. J.G. Varshney,
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14. Dr. R.K. Choudhary,
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15. Dr. Rambir Singh,
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16. Dr. S.K. Bhatnagar,
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17. Dr. N.P. Agnihotri,
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18. Dr. S. Lal,
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19. Dr. J.S. Yadav,
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35. Dr. S.B. Maini,
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36. Dr. S.M. Paul Khurana,
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37. Dr. D.S. Rathore,
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40. Dr. P.G. Ranjendran,
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49. Dr. M. V. Singh,
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51. Dr. D.K. Painuli,
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52. Dr. P.S. Minhas,
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53. Dr. R.K. Batra,
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ENGINEERING AND TECHNOLOGY

56. Dr. A.K. Bhattacharya,
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68. Project Coordinator(Crop Based Animal Production Systems), Indian Grassland and Fodder Research Institute, Pahuj Dam, Gwalior-Jhansi Road, Jhansi-284 003 (Uttar Pradesh)

69. Project Coordinator(Embryo Transfer), Indian Council of Agricultural Research, Krishi Bhavan, New Delhi-110 001

70. Dr. B.U. Khan,
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71. Dr. S.S. Bhatia,
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72. Dr. S.D.J. Bohra,
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73. Project Coordinator(Foot-and-Mouth Disease),
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74. Project Coordinator(Haemoprotista Disease), College of Veterinary Science,
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75. Project Coordinator(Organic Waste in Aquaculture), Indian Council of Agricultural
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77. Dr. M.C. Goel,
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GENERAL

78. Dr. Y.S. Ramakrishna,
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ANNEXURE-II

INVENTION DURING LAST THREE YEARS

ACHIEVEMENTS

1. FRUIT CROPS

A mango hybrid, CISH-M-2, a cross of Dashehari X Chausa performed excellently. This hybrid has good potential because of its sooty mould free fruit surface even after exposure to heavy rains. The fruits are similar to those of Dashehari but mature 15 days after Dashehari.

Evaluation of mango hybrids at the IIHR, Bangalore, indicated that Hybrid H 18 (Alphonso x Kensington) had better fruit quality. The evaluation of mango gerrnplasm showed that `Pakhirwala` had maximum fruit weight (404 g), Xavier highest TSS (24.80Brix) and Kensington had maximum pulp recovery (74%).

Two guava selections, viz. CISH-G-2 and CISH-G-3 were found to be promising. CISH-G-2 has attractive fruits with crimson colou

and white stripes with soft and few seeds. CISH-G-3 has attractive fruits with pink flesh. It is suitable for both table and processing purposes. The pink colour in the beverage remains stable for more than a year of storage.

A ber selection named as `Gohah Kirti` was developed at CHES, Godhra for cultivation in tribal belts of Gujarat, Maharashtra and Madhya Pradesh. This is an early variety and escapes incidence of fruit borer and fruit fly.

A papaya hybrid H-39 (Sunrise SoloX Pink Flesh Sweet) was found better than Coorg Honey Dew. It is better than Sunrise Solo with regard to quality and yield. A hybrid line CP 81 (Coorg Honey Dew X CP85) was identified for high yield and quality. A promising hybrid from the cross of CO-5X Thailand was obtained and purified.

A pomegranate hybrid `Ruby` has been released. The fruit has red bold arils, soft seeds, red ring, good keeping quality and high TSS even during summer. Leaf nutrient standards were developed for Ganesh cultivar of pomegranate (0.40 to 2.20% N, 0.12 to 0.18% P and 0.61 to 1.59% K for fruit yield of 15.60 to 18.80 tonnes/ha). In Bijapur district of Karnataka and Nasik district of Maharashtra, N,P and Zn were most limiting nutrients.

2. VEGETABLE CROPS

In vegetable crops, 17 open pollinated varieties including 3 in brinjal (long) 2 in brinjal (small round), one each in brinjal (round) and brinjal (green), 2 in bitter gourd, 3 in Pea (mid season), one each in tomato (indeterminate), garlic, cowpea, onion and French bean and 11 F I hybrids including 2 each in brinjal, chilli, cabbage, tomato (determinate) and Okra and one in bitter gourd and one tomato variety BRH-2 resistant to bacterial have been identified for cultivation in different agro-climatic zones of the country.

A number of improved agro-techniques such as fertilizer application through basal, top dressing and foliar spray, spacing and herbicidal application have been worked out and recommended for different vegetable crops for different regions for higher economic returns. For pest and disease control, improved schedules and chemicals have been worked out/identified and recommended minimizing incidence.

In mushroom, two single spore strains NCS 100 and NCS 101 and one hybrid NCH 102 of white button mushroom (agaricus bisporus) have been released for commercial cultivation alongwith package of production of practices.

3. POTATO & TUBER CROPS:

The CPRI, Shimla, has released Kufri Pukhraj and Kufii Anand, new potato varietiesKufri Pukhraj is an early bulking, resistant to late blight and suitable for north Indian plains and plateau areas, whereas Kufri Anand is suitable for cultivation in western and central Uttar Pradesh. Kufri Anand provides resistance to late blight, attractive, oblong tubers with fleet eyes and pale yellow flesh. Potato variety Kufri Giriraj, a substitute for Kufri Jyoti, which has become susceptible to late blight disease in hills has also been released. Varieties Kufri Chipsona I and Kufri Chipsona 2, ideal for processing and resistant to late blight, have since been officially notified by the Central Variety Release Committee. A hybrid Kufri Thenamalai, resistant to both the species of cyst nematodes and late blight and suitable for cultivation in Tamil Nadu hills is likely to be released by the Tamil Nadu Government.

In Punjab, potato-onion-groundnut was found to be the most productive cropping system. In Bihar region, potato-bottle gourd-paddy and in western Uttar Pradesh, potato- bottle gourd-urd cropping system were found promising. Cropping sequences like Potato jute-paddy at Kalyani in West Bengal and potato-tomato-spinach-radish at Srinagar in J & K were found remunerative.

In cassava, two varieties Sree Jaya and Sree Vijaya with an average yield of 34 and 32 tonnes/ha respectively suitable for lowland cultivation as a rotation crop in a paddy-based cropping system, Sree Shilpa, a hybrid of Dioscorea alata with an average yield of 28 tonnes/ha and Sree Padma a selection of elephant-foot yam have been released for cultivation in Kerala state. Sweet-potato variety Sree Bhadra for the All-India release and colocasia varieties NDC I and NDC 2 for Uttar Pradesh and Kadma for Bihar Plateau have been recommended by the AICRP on Tuber Crops. The regional centre of the CTCRI at Bhubaneswar has released sweet potato varieties namely Gouri (19 tonnes/ha) and Sankar (14 tonnes/ha) for cultivation in the eastern parts of the country. In Cassava, two short duration clones, namely CI 649 and C1-731 with a yield potential of 25-30 t/ha in six months and a superior clone of Amorphophullus, AM-15 with a yield potential of 42 t/ha were identified by CTCRI for release.

Biological Management of Sweet potato Weevil was effective using braconid parasitoid, Rhaconotus menippu @ IO pairs/sq. in plot and Metarhizium enisopliae @ 3 X109sq/m at 50 DAP along with re-ridging at 65 DAP. It gave 75% protection over check. The pheromone traps prepared by the BARC, Mumbai, reduced the sweet-potato weevil damage on tubers considerably at Dholi, Hyderabad, Coimbatore, Dapoli, Bhubaneswar and Thiruvananthapuram. Sweet-potato Sree Bhadra was identified as an excellent trap crop for the management of root-knot nematodes. The population of nematode declined to below detectable level in naturally-infested fields of Sree Bhadra over a period of 90-95 days.

4. FLORICULTURE & MEDICINAL PLANTS:

In rose, three new hybrids, were developed at the IARI, New Delhi. One induced mutant of rose variety Paradise was promising for garden display at the IIHR, Bangalore, and white-coloured mutant of Sylvia was promising at the NBRI, Lucknow. Rose variety Dr. B.P. Pal at the IARI, New Delhi, and Sonia Meiland at the PAU, Ludhiana, were suitable for the export purpose. Rosa mullfora was identified as the best rootstock in rose under Bangalore and Kalyani conditions, whereas Rosa indica var. odorata proved better for Tamil Nadu.

In gladiolus, nine new varieties, Anjali (bright orange), Archana (Scarlet Pink with yellow dusting on wavy falls in the throat region), Bindiya (yellowish-cream with fan-shaped red colouration at 2 side falls), Chandani (greenish-white), Chirag (orange- yellow), Sarang (purple red), Shweta (white with light yellow throat), Sunayana (pinkish red) and Vandana (bright orange), have been released by the

IARI, New Delhi. Two varieties, namely, Rajani and Chandrani, have also been released from Kalyani.

Three improved varieties of Chrysanthemum, namely, White Charm from Lucknow; Basanti and KS 16 from Kalyani have been released.. Chrysanthemum varieties, IIHR 6, IIHR 13, CO 1, C02, Vasantika and Megami performed well at different centres. Ar induced mutant of chrysanthemum Kirti was promising for bedding and potting. At Lucknow, 3 flower colour mutants, (White, Yellow and Brown) in Maghi and 2 mutants, (White and Dark Red) in Shyamal were isolated and multiplied. The centre has also released a new no-pinch no-stake variety as Mother Teresa which bears white small flowers of Argemone type. It blooms in early December and is highly suitable for pot culture. One attractive hybrid Punjab Gold has been developed for pot culture.

In carnation, cultivar Laurella at Ludhiana, Fambia at Pune and Arthur Sirn at Kodaikanal were promising.

In orchids Epidendrum radicans and Spathoglottis plicata flowered throughout the year, the largest flowers being in New Pink. Longest inflorescence was recorded in Jay Sweeking x Jaq. Concert at Vellanikkara. The Dendrobium crepidatum recorded maximum number of flowers/inflorescence (27.7). The Phaius tankervillae showed longest stalks (84.5 cm), whereas Cymbidium lowianum produced largest flowers (11.5 cm) at Yercaud.

The marigold hybrid MS-8 x Pusa Narangi Gainda, developed at the IARI, New Delhi, was promising. New marigold Pusa Narang Ganida was significantly superior to local marigold at Pune.

Gerbera Presley gave best performance with regard to plant height (26.2 cm), plant spread (I 15.8 cm2) and flower yield (21.8 flowers/plant) at Vellanikkara, whereas Polar recorded highest number of flowers (51 flowers/plant) at Pune.

In China Aster, Kamini, Poornima and Pure line 8 performed well at different centres.

5. PLANTATION CROPS:

Standardization of enzyme extraction and PAGE was done in leaf samples of Tall and Dwarf coconut varieties. A protocol for DNA extraction from newly emerged leaf of coconut has been standardized. A more efficient collapsible copra dryer has been fabricated. Descriptor for 26 cultivars of coconut and 16 indigenous accessions of arecanut have been completed. Coconut based cropping system continues to give increased net return per unit area. An auto irrigation system to overcome the problem of low voltage has been standardized.

6. SPICES:

In black pepper six hybrid lines and one cultivar have been short listed for high altitude areas of South India. Root knot nematode resistant variety `Pournami` has been released. In ginger, IISR Varada has been released for Kerala but it is also found promising in A. P. and Orissa under AICRP on Spices. IISR Prabha and IISR Pratibha the two value added turmeric varieties developed throug open pollinated progeny selection have been released for Kerala and Tamil Nadu. Protoplasts were isolated from in vitro derived leaf tissue of cardamom, ginger and tunneric. Micro-calli were developed from protoplast of cardamom. Integrated disease management involving mixtures of Phytphthora tolerant pepper lines, biocontrol and chemical control have been set up both under pure crop and mixed cropping system. Potassium phosphate in combination with Trichoderima was found to be very effective against foot-rot.

Sonali, a new tumeric variety resistant to rhizome rot, leaf blotch and scale insect was evolved. A new ginger accessions(V,S,-8) with 8.75% oleoresin content is identified. Cordiander (CC-748), cumin (JC-147) and fennel (RF-125) having 0.45 %, 3.0% and 2% volatile oil were identified. High density bush pepper cultivation was standardized.

7. POST-HARVEST MANAGEMENT:

CFB boxes both common as well as made from cotton stick pulp were suitable for transportation and storage of Alphonso mango. Alphonso mangoes could be kept in good condition upto 34 days with minimum incidence of spongy tissue (5%) if they are hydro-cooled in combination with bavistin treatment followed by storage at 12 (I C with 85% Relative Humidity.

Modified Atmosphere Packaging (MAP) technology for mango, banana, pomegranate, guava and citrus fruits using various polymeric films and shrink wrapping showed promising results in their keeping quality even upto one month which could be extremely useful both for domestic marketing and export trade.

Several innovative processed products from fruits viz. Ber Candy, Ber Churah, Dried aonla shreds, Cherry Nectar, Osmotically dried apple rings and oil less aonla pickles have been developed and standardized. Technique for oil-less mango pickle preparation has been standardised. A prototype of hand operated fruit coring device was developed for removing cores from apple and pineapple fruits.

The raw mango processing machine has been developed at the IIHR, Bangalore. The industrial prototypes of raw mango processing machine having a capacity of 25 tonnes/day have been designed. The labour requirement is only one-sixth as compared with manual operation for slicing and cube cutting of mangoes into cubes of 1Og. Weight for pickle-making.

8. Farm Implements and Machinery

A large number of Farm Implements and Equipments have been developed and evaluated for carrying out different farm operations as given below:-

1. Seed Bed Preparation: Spiked clod crusher, Tractor operated hydraulically controlled wettand puddler, animal drawn lugged wheat

puddler, multipurpose animal drawn equipment.

2. Sowing and Planting: Power tiller operated till planter, mustard drill, multicrop planter, pre-genninated paddy seeder, manual operated six row mat-type paddy transplanter, eight row self propelled rice transplanter, power tiller operated Jyoti Planter, Strip-till, drill, no-till-drill.

3. Interculture and Spraying: Power weeder, self-propelled boom sprayer and overhead sprayer.

4. Harvesting: Groundnut harvester, Sorghum harvester and heavy duty augur digger.

5. Threshing: High capacity multi-crop thresher, Groundnut Thresher, Sunflower Thresher.

6. Transportation: For transportation for farm produce an improved standard 2-wheel bullock cart has been developed.

7. Ergonomics and Safety: Ergonomics studies on power tiller, collection of anthropometric data of agricultural weekers, accidents and ergonomical problems in agricultural and allied activities in Madhya Pradesh.

8. Establishment of Computer aided design facility for designing of agricultural machinery: Design refinement and preparation of production drawing and manuals of related equipments like tubuler maize sheller, groundnut decorticator and 3-row animal drawn seed drill.

9. Prototype manufacturing: A large number of prototype equipments have been developed and supplied to various centres and KVKs for large- scale adoption and popularization.

9. Post- Harvest Engineering & Technology

A large number of Post-harvest Technologies have been developed as given under:-

1. Grading: Groundnut pod grader and weight based fruit grader.

2. Shelling and Decortication: Chili seed extractor, tamarind seed extractor and sheeter and stripping -cum-shelling machine.

3 . Horticultural Crops: For fruits and vegetables equipments developedinclude a two stage evaporative cooler for fruits and vegetables. Studies on osmotic dehydration of fruits and vegetables and modified atmosphere packaging studies on hybrid cultivars of tomato, have been made.

4. Honey: For extraction of honey few equipments/gadgets have been developed such as tractor operated smoker, electrically heated stainless steel uncapping knife and stainless steel 8-frame honey extractor.

5. Cotton: A two-step process for making pulp from crop residues has been standardized.

6. Jute : An improvised model of power ribboner has been developed. The method for retting of green jute ribbons has been standardized.

7. Jaggery: A sugarcane juice boiling furnace has been improved. A digital thermometer with a clamp on its probe was developed. A hardness tester was modified for solid jaggery.

10. Animal Sciences:

Animal genetic resource evaluation and conservation through extensive surveys, genetic characterization using gene markers and of indigenous livestock and poultry breeds. Genetic improvement for milk, meat, fibre and draft in various livestock species through selection, progeny testing and MOET schemes. Improvement of poultry for Meat and Egg. Improvement in productive and reproductive efficiency by encouraging the efficiency of straw utilization, mineral nutrition, by manipulation of rumen fermentation pattern, feeding of by pass protein, protected fat and plane of nutrition was achieved. Buffalo breeds improved for high milk production. Studies on semen evaluation, breeding efficiency, lactation performance, thermo regulatory characteristics and endocrine profile, cryo-preservation of semen and embryos of various livestock species conducted. Haematological and biochemical parameters of Mithun; thermo adaptability, immunoglobulin pattern, different mineral and enzymes studies; reproductive behaviors and induction of lactation using 17 B estradiol and progesterone in Yak initiated. For the first time Yak was maintained at altitude less that 2000 m MSL and mithun was domesticated for in house maintenance. Urea-molasses black developed for `better nutrition vis-a-vis production. Technology for indigenous milk product developed such as khoa, paneer, gulab jamun mix, carrot-milk halwa mix, mango milk shake mix shake mix etc. Technology for whey protein concentrate have been developed through applications of membrane tech. Equipments have been designed and fabricated for indigenous milk products. Technologies have been given to farmers and industries for better return to the farmers. Diagnostics and vaccines against various diseases like Brucella, leptospira, infectious bovine rhinotracheitis, infectious bursal disease, Avian leucosis complex, hemorrhagic septicemia, equine influenza, Foot and Mouth Disease, Equine infectious anemia, herpes virus, salmonella have been developed for the control of disease in livestock and poultry. It has been shown through empirical analysis that crop diversification through incorporation of legumes has enhanced the total factor productivity of rice- wheat based cropping system. Investment in livestock research gave returns. Expenditure must on irrigation, rural roads, rural electrification etc. for agricultural development. Action plan decided for private-public sector interface. Survey method developed for precise estimation of milk production at district level. Software developed to add, retrieve, and analysis the date available in database on agriculture statistics. Crop yield estimate possible with the use of satellite data. Model developed to study spread of aphid population. National Information System on Agricultural Education (NISAGE) developed.

11. Fisheries:

MAJOR INOVATIONS DURING LAST THREE YEARS:

MAHIMA: The Shrimp Feed: Nutritional research on economical feed production and efficient feeding strategies resulted in the development of Mahima - a need based onfarm shrimp feed production technology for the rural sector. Two formulations based on the nutritional requirements of commercially important shrimp Penaeus indicus and P. monodon were developed by CMFRI and disseminated to rural women. The technology transfer has resulted in the establishment of three fully operational all-women manned small scale shrimp feed units. Mahima has proved itself to be highly efficient in terms of production both under laboratory and field conditions, giving feed conversation ratios (FCR`s) of 1.5 (P.indicus) and 1.7 (P.monodon) respectively.

Seabass Breeding And Culture: The CIBA has achieved a major breakthrough, for the first time in the country, in the captive broodstock development, induced breeding and seed production of the Asian seabass Lates calcarifer. Hatchery-produced seabass seed were sold to progressive fish farmers.

CIFAPRA - Freshwater Prawn Feed : Feed is the major input in a prawn hatchery and grow-out operations and nutritionally balanced, cost-effective diets for various life stages of the prawn are vital for obtaining rapid growth, high survival and sustainable production levels. Formulated feeds for different life stages of the prawn have been developed and formulation is being popularise through demonstrations to aquafarming community.

CIFACA - Carp Baby Feed: A cost effective feed for carp spawn comprising groundnut cake, roasted soybean meal, fish meal, rice bran, mixture of vegetable and fish oils, vitamin-mineral premix and probiotic supplement has been developed and being marketed in the rural aqua sector.

CIFAMA - Magur Baby Feed : Feed has been prepared using fish meal, roasted soybean meal, groundnut cake, tapioca powder, baker`s yeast, vegetable oil, vitamin-mineral premix and an attractant. The formulation is in the process of commercialisation.

Seed Production of Golden Mahseer Tor Putitora: Establishment of flow-through mahseer hatchery and production of stocking material (fingerlings) of golden mahseer. To produce healthy stocking material of golden mahseer in captivity, efforts were made to grow juvenile of this species in nylon cage floated in a himalayan lake, Bhimtal. The package of practices so evolved would be highly effective for in-situ conservation programmes of this endangered species in natural closed systems for replenishing their population and augmenting their production both for food and sport which in turn would help in hill/tribal area development

Improved Rohu CIFA-IR: The genetically improved rohu variety has shown a 25 % improved growth performance over local stocks. This improved rohu CIFA IR I - is being released to other region of the country to evaluate the performance in different agro-climatic zones as genetic characters are considerably influenced by the environment.

Collagen -Chitosan membrane - a boon to periodontist: The collagen-chitosan membrane developed by CIFT possesses haemostatic and healing properties. This is the first time that the membrane is being used for periodontal Guided Tissue Regeneration (GTR) applications. This new membrane can be an effective substitute for the synthetic Teflon, which is now the gold standard for GTR procedures. The membrane may find application in plastic surgery also for repairing damages due to burns and wounds.

12. Crop Improvement and Management :-

Germplasm accessions of different crops have been evaluated and promising lines identified for major economic traits such as resistance to diseases and pests, drought, superior quality etc.

Package of practices have been developed for different crops to maximize yield from the improved varieties and hybrids.

Breeder seeds of different crops produced during the last 3 years is given below:

1996-97	29487.61q
1997-98	26486.53q
1998-99	23023.89q

More than 10 thousand germplasm accessions of various crops were collected from different parts of the country and more than 30000 accessions were added to the base collection for long term conservation in the National Gene Bank at National Bureau of Plant Genetic Resources, New Delhi.

36 released varieties of barley and 35 released varieties of durum wheat were analysed for DNA finger prints. Besides this DNA finger printing was successfully achieved in 48 aromatic rice genotypes, 96 Indian wheat cultivars, 70 varieties of cotton and 30 varieties of tomato.

Biodiversity of natural enemies has been mapped, catalogue of reference collection of natural enemies prepared and a national Repository of Natural Enemies established.

Indigenous techniques have been evolved for multiplication of 60 host insects.

Superior strains (Bio CI and Bio C2, Bio Sc I BioHI) of Trichogramma chilonis have been determined for cotton, sugarcane and tomato crops.

An efficient isolate of fungal antagonist, Trichoderma harzianum was found to Manage wilt and root rot complex of chickpea.

An endosulfan tolerant strain of Trichogramma chilomis, an important egg parasitoid of lepidopteran pests has been evolved.

Large scale demonstrations proved the effectiveness of natural enemies on rice, maize, sugarcane, tobacco, cotton, tomato, grapes, guava and other crops. Mass production and demonstration of the impact of nd to be deficient in zinc and iron respectively.

- Fine grain rice variety CSR 13 of the CSSRI, Karnal was recommended for release, whereas CSR 21 (CSR 8871 R 1) and CSR 2 (CSR 881 R 1) were recommended for minikit trials for inland saline and sodic soils.

- Sulphitation pressmud and farmyard manure are promising components of integrated nutrient supply and 25% chemical fertilizer dose of rice in rice-wheat cropping system can be curtailed safely with use of these organic sources.

- Keeping in view the control of Phalaris minor in wheat areas, experiments were carried out using new herbicides. The application of sulfosulfuron @ 45 g/ha at 1-3 leaf stage (25 DAS); fenoxaprop @ 90 g/ha; metribuzin @ 300 g/h and tralkoxydim at 30-35 DAS were found to decrease the weed population.

- Under irrigated conditions of Hisar and ecosystem, intensive cropping of pearlmillet-potato-tomato has been found feasible and more productive and remunerative than conventional pearimillet-wheat system.

- Promising new cropping systems under sub-humid climate are : maize-pea- potato at Palampur, rice-potato-wheat at R.S. Pura, rice-berseem.at Raipur, rice- tomato-okra at Chiplima and under coastal system are rice-groundnut and rice- rice sesame at Kariat.

- Aonla in degraded soils of Shiwalik foothills : Aonla-based horti-pastoral system was established on degraded land in Shiwalik foothills of Chandigarh. Average yield of aonla was 29 kg/tree as a sole crop as well as with pigeonpea. The yield on area basis was 12 and 14 tonnes/ha respectively with sole aonla and aonla with pigeonpea.